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Count Rumford: Designer of Clothes

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When developing a concept in class, I think all teachers realize the importance of taking into account the attention span of their students. One report I read felt that most college students can maintain a good 30-minute attention span, whereas seventh grade students can only average a period of four to five minutes of concentration on a speaker.

During the course of teaching some classes of seventh grade science these last three years, I have found that a good story now and then helps to maintain their attention span or to bring back their wandering minds. As I will point out later, I am also convinced that these stories, when properly related, convey certain concepts, the mastery of which the student demonstrates on subsequent tests. I remember, in particular, the inundation of questions about Albert Einstein after I related the story of how he convinced his second wife to give his Nobel Prize money to his first wife because she had stayed with him through his rough early years. When we were discussing Tycho Brahe's contributions to the development of measurement in astronomy, the story of how he got his gold nose sparked the students' interest. Mentioning that Enrico Fermi polished only the front parts of his shoes, when we were discussing his contributions to atomic energy, again helped to maintain their interest.

Seeing what I felt was a positive response when these stories or anecdotes were related, I decided to try a bolder approach—a full period story—to see if more attention time could be evidenced. My first attempt was to use the essay *The Method of Scientific Investigation* by Thomas Henry Huxley. This particular essay includes a humorous discussion about how one forms an opinion of apples that are green and sour and how this opinion can be expanded to include all apples that are green and sour. But what I thought would be the most effective part of the essay was the part in which Huxley puts the reader in the role of a detective solving a crime.

This method wasn't too successful because the essay was six pages long, and just the appearance of the manuscript shortened their attention span to much less than four or five minutes. I salvaged some concepts from this essay by summarizing the essay in a few sentences which I put on the board. The deduction process of the detective story did provide interest then.

Thus realizing the reading and attention limitations of my students, I stuck to using short story problems to help illustrate deductive and inductive reason-

ing. For instance, I used the story of the farmer who had to cross a river taking a fox, a chicken and some corn but who was limited because he could take over only one at a time. The problem was introduced when the students realized that neither the chicken nor the corn were to be eaten. This story was well received and most student groups figured out how to do it within 15 minutes after they identified the assumptions of the problem.

Seeing the apparently higher degree of success of these shorter stories, I used a few more. The story of how a king determined the wisest man in his kingdom by using red and white hats again sparked my students' interest while demonstrating the concept of deductive reasoning.

When we started studying the concept of heat and heat transfer, I remembered a supplementary book for PSSC Physics entitled *Count Rumford: Physicist Extraordinary*. I was especially pleased with this book because I had always thought of Count Rumford as some obscure man who help to bore some cannons and noted that heat was continually generated as long as the boring continued. His observations, of course, helped to disprove the then quite obvious caloric theory of heat. But this book revealed a much more complete and influential man. His effect on American and European society was most refreshing to trace.

Remembering both the partial success and failure of the Huxley essay, I decided to try a full-period story using Rumford's life. I modified my approach by summarizing the man's life with personal anecdotes with which my students might identify and ending with one of the major problems Rumford faced. I then had the students use their acquired knowledge on heat from classwork to predict what he probably did. After they spent a class period working with their lab partners, I handed out a paper which showed how Count Rumford solved the problem and emphasized how close their solutions were to his solution.

The handout I used appears below. The first few points establish Count Rumford as living during the American Revolution. The time schedule that he kept in points 6 and 7 was well discussed by the students. Points 8 thru 17 didn't spark much interest, but point 18, which described his secret ink, provided a tangent for talking that I had to cut short so I could finish the rest of the story. I placed the majority of my emphasis on the two problems Rumford faced: that of providing food and clothing for the Bavarian army. I didn't have time to explain how Rumford made extensive tests on foods and how he convinced the army to grow gardens containing potatoes which were then almost unknown and initially disliked. Count Rumford's influence on garden growing is still evident in Munich today. I did relate the story how he solved the problem of getting the soldiers to eat slower. Rumford felt that the nutritional value of Rumford Soup wasn't gained by the men if they ate it too fast so Rumford introduced croutons to extend eating time.

Since we had covered the concept of thermal conductivity, I had the students predict how Count Rumford found the best material to use for uniforms.

The response was tremendous and tremendously imaginative. Time doesn't permit me to mention all these, but I can relate a few.

Some of my students actually repeated Rumford's method with over 50 types of clothing combinations, and two students investigated the methods Rumford used to get the beggars of Munich to produce these new uniforms and how Rumford set up one of the first public schools. Another group reconstructed the fireplaces Rumford developed which still grace many homes and castles of Europe today. The enthusiasm generated by this period-long story was most rewarding for the students and their instructor.

(HANDOUT)

Count Rumford: Physicist Extraordinary

The following is a brief resume of the life of Benjamin Thompson (Count Rumford). You might find this helpful in understanding what influences a society can have on a man and what influences a man can have on society.

1. Count Rumford (Benjamin Thompson by birth) was born on March 26, 1753 in Woburn, Massachusetts.
2. At the age of 13 he began work for an importer of dry-goods merchandise in Salem, Massachusetts for three years.
3. Due to the high taxes imposed by the British on dry-goods merchandise, Ben's boss banded together with other merchants to protest the high taxes. As a result of lost business, Ben was laid off.
4. Ben was recommended for a similar job in Boston.
5. After a year working in the dry goods store in Boston, when he was 18 years old, he went to work as an apprentice for a local physician.
6. He did quite a bit of studying on his own:

Munday—Anatomy

Tuesday—Anatomy

Wednesday—Institutes of Physick

Thursday—Surgery

Friday—Chemistry with the Materia Medica

Saturday—Physick $\frac{1}{2}$ and Surgery $\frac{1}{2}$

7. Each hour of the day was also planned in advance:

1

2

3 Sleep

4

5

6 Get up at Six o'clock and wash my hands and

7 face

8 From 8 till 10 Breakfast Attend prayers etc.

9

10

11

12 From 10 to 12 Study all the time

1

2

3 From 1 to 4 Study—Constantly

4 From 4 to 5 Relieve my mind by some

5 Diversion or Exercise

6 From 5 till Bed time follow what my

7 inclination leads me to whether it be to a broad
 8 or stay home and read either Anatomy, Physicks
 9 or Chymistry or any other book I want to
 10 Persue
 11
 12 Sleep

8. He was almost killed when he tried to repeat Ben Franklin's kite experiment with lightning.
9. Ben decided to teach school and did so near Boston.
10. He taught school in Concord, New Hampshire, and after only four months he married a rich widow 11 years older than he was.
11. He helped the Governor carry out a survey of the White Mountains and impressed the Governor with his brilliance.
12. Ben then settled down in his role as a country gentleman and did various experiments on the growing-abilities of various crops.
13. So impressed was the Governor with this 20-year-old colonial squire, he appointed Ben major in the New Hampshire Militia.
14. This appointment was quite controversial, but Governor Wentworth had his purpose. The colonists desperately needed drill masters and military instructors and were willing to pay tremendous bonuses to entice British regulars into deserting to the armies that were being assembled secretly throughout the colonies. To combat the subversion, the Royal Governors did all they could to enlist spies and informers for the royal cause.
15. Early in December, 1774, Major Thompson was summoned before the Committee of Safety to answer charges of being unfriendly to the cause of freedom.
16. The case was dismissed, but Major Thompson fled from his home before some hotheads could tar and feather him.
17. Ben did offer his services as a New Hampshire major to Colonel George Washington, but the record of his behavior preceded him.
18. Ben developed and used a secret ink consisting of gallotannic acid which was obtained by soaking nutgalls in water. (Nutmeg powder was used as an anti-diarrhea drug, a fact which Ben might have learned while apprentice to the doctor in Boston.) Ferrous sulfate developed the ink.
19. Ben went to London and became a private secretary for five years to Lord George Germain, a professional soldier who was court-martialed for cowardice in battle and who had turned to politics to bolster his damaged reputation.
20. During this time Ben worked with a ballistic pendulum but measured the recoil of the guns rather than the velocity of the bullets.
21. Thompson also undertook a fundamental study of the tensile strength of silk fiber under all kinds of conditions with the hope of improving the uniforms sent to the British troops in America.
22. At that time in Europe, one of the most useful functions a wandering soldier of fortune would perform was that of a political informer.
23. Thompson offered his services as a military aide to Bavaria and was accepted.
24. The Bavarian army was numerically large but almost useless as a fighting force because its organization was so poor, its morale low and its soldiers so ill-equipped. The Bavarian court stood in constant fear of aggression from without and disintegration of the army from within. Colonel Thompson's real job seems to have been that of confidential adviser to the Elector of Bavaria, with the idea of recommending and carrying through reorganization of the army.
25. When Ben analyzed the military budget, it became obvious that the two largest items of expenditures were the soldiers' food and clothing.

26. First—were the soldiers wearing the best possible kind of clothing?

COLONEL BENJAMIN THOMPSON HAD THE PROBLEM OF CLOTHING THE BAVARIAN ARMY. HOW TO DO THIS IN THE MOST ECONOMICAL WAY POSSIBLE AND STILL KEEP THE SOLDIERS WARM AND HAPPY WAS COUNT RUMFORD'S JOB.

YOU ARE TO DO THE FOLLOWING: IN AT LEAST 100 WORDS, DESCRIBE AN EXPERIMENT OR A SERIES OF EXPERIMENTS WHICH YOU THINK COUNT RUMFORD MIGHT HAVE DONE TO SELECT AND DESIGN WARM UNIFORMS FOR THE SOLDIERS OF THE BAVARIAN ARMY.

Iowa Science Teachers Journal to be Distributed Only as Requested

The Board of Directors, acting on the results of a survey of interest in the *Journal* and recommendations of the Publications Committee, decided to reduce this publication to three issues per year and to distribute it to those in the Academy who indicate in-

terest in the Science Teaching Section. In addition, it will be mailed to *any* Academy member who wants to receive it, but *it will be the responsibility of the individual member to inform the central office of his desire to receive the Journal.*

Write to: Robert W. Hanson, Executive Secretary, Iowa Academy of Science, University of Northern Iowa, Cedar Falls, Iowa 05613.

Science Teachers Look at Themselves and Their Schools

The National Science Teachers Association is offering science teachers new materials to help them get a better look at their own professional development and at the conditions under which they work. Two major reports just off the press, the *Annual Self-Inventory for Science Teachers (ASIST)* and *Conditions for Good Science Teaching in Secondary Schools*, should aid science teachers in improving their situations by setting standards for their own performance, for their schools and for their school systems.

ASIST is a four-page statement-and-answer booklet, included in the December 1970 issue of *The Science Teacher*, in which the teacher is asked to evaluate himself as objectively as possible. A series of statements provides operational meaning for each of seven general characteristics of the "Professional Science Teacher." According to ASIST, such a person "is well educated in science and the liberal arts, possesses a functional philosophy of education and the technical skills of teaching, continues to grow in knowledge and skill throughout his career, insists on a sound educational environment in which to work, maintains his professional status, contributes to the improvement of science